



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
Manchester, Washington 98353

LDWSF
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08/20/85

REPLY TO
ATTN OF:

M/S Lab

August 20, 1985

MEMORANDUM

SUBJECT: Toxicity Test Results: Marine Power and
Equipment Company Investigation

FROM: Joseph M. Cummins *Joe Cummins*
Aquatic Biologist

TO: Sylvia Kawabata
Environmental Engineer

THRU: Arnold R. Gahler, Chief *Arnold Gahler*
Laboratory Branch

Presented in the attached report are the results of the toxicity screening tests performed on unused sandblasting sands and sediments collected in conjunction with the investigation of Marine Power and Equipment Company sites on Lake Union and the Duwamish Waterway.

Two different toxicity tests were used to measure the acute toxicity of the samples collected. The unused sandblasting sands were assayed by both the 10-day, marine amphipod bioassay and the 48-hour, freshwater daphnid bioassay. However, because of the estuarine character of the Duwamish Waterway sediments, they were tested using only the marine amphipod test. The (freshwater) Lake Union sediments were tested using only the freshwater daphnid test.

In summary, the exposure of daphnids to both the unused sandblasting sands and the Lake Union sediments resulted in 0% survival. Daphnid survival in the control sediment ranged from 63% (aerated) to 90% (unaerated).

The exposure of amphipods to the unused sandblasting sands resulted in only 10-34% survival. Amphipod survival in the Duwamish Waterway sediments ranged from 17-74%, while 97% amphipod survival was observed in the control sediment.

Please let me know if you have any questions.

cc: Dick Bauer
Mike Johnston

SAND
Sediments
Control

Survival	Amphipods	marine amphipods
0%	0%	10-34%
0% Lake Union sediments	0%	17-74% Duwamish sediments
63-90%		97%

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Water Permits & Compliance Branch
Permits Section

Σ: Amphipods most sensitive to sand
sediments all amphipods
Lake Union sediments killed all amphipods
Duwamish sediments killed all but 17-74%
amphipods

USEPA SF



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RESULTS OF TOXICITY TESTS CONDUCTED ON UNUSED SANDBLASTING SANDS
AND SEDIMENTS COLLECTED ADJACENT TO MARINE POWER AND EQUIPMENT
COMPANY SITES ON LAKE UNION AND THE DUWAMISH WATERWAY

Joseph M. Cummins
Carolyn E. Gangmark

August 20, 1985

U.S. Environmental Protection Agency
Environmental Services Division
Region 10 Laboratory
Manchester, WA 98353

TOXICITY SCREENING TEST RESULTS

Identification of Samples Tested:

1. Unused Sandblasting Sand -
"TUF KUT"
R. A. Barnes, Inc.
Seattle, WA
(EPA Lab No. 85250850)
2. Unused Sandblasting Sand -
Kleen-Blast®
Kleen-Blast Co.
1448 St. Paul Avenue
Tacoma, WA 98405
(EPA Lab NO. 85250851)
3. Duwamish Waterway Sediment #1-
30 feet in from syncro-lift
(EPA Lab No. 85250852)
4. Duwamish Waterway Sediment #2-
adjacent to upstream dolphin
near syncro - lift
(EPA Lab No. 85250853)
5. Lake Union Sediment #1-
Middle slip, west side of
Marine Power & Equipment
(EPA Lab No. 85250854)
6. Lake Union Sediment #2-
10-15 feet of dry dock
(3rd from W.)
(EPA Lab No. 85250855)

Date of Test:

Marine Amphipod Bioassay - June 21-July 1, 1985
Freshwater Daphnid Bioassay - June 26-28, 1985

Testing Facility:

EPA Region 10 Laboratory
P.O. Box 549
Manchester, WA 98353

Analysts:

Joseph M. Cummins, Aquatic Biologist
Carolyn E. Gangmark, Aquatic Biologist

Sample Collection:

Samples of unused sandblasting sand were obtained by Sylvia Kawabata, EPA Region 10, from R.A. Barnes, Inc. and the Kleen-Blast Co., the morning of June 14, 1985. These samples of sand were stock materials packaged in unopened, paper bags (Net Wt. 100#). The unopened bags were stored at room temperature until prepared for testing.

Bottom sediments were collected adjacent to the Marine Power and Equipment Co. sites on the Duwamish Waterway and Lake Union the mornings of June 18 and 19, 1985, respectively. These samples were collected in chemically-clean glass jars by members of the EPA Region 10 Dive Team.

After collection, the samples were placed on ice in an ice chest and transported to the EPA Region 10 Laboratory where they were stored at 4°C until prepared for testing.

Bioassay Methods:

The acute toxicity of the sandblasting sands and the Lake Union sediments was measured using a 48-hour, daphnid sediment toxicity test modified after a method developed by Nebeker et al., (1984). Toxicity was based on the survival of the freshwater daphnid, Daphnia pulex, introduced into the water column above the sample.

These tests were conducted using three aerated replicates and one un-aerated replicate. Each replicate consisted of 60 grams of sample and 200 mL of daphnid culture medium seeded with 10 daphnid neonates < 24 hours old. Washed and dried West Beach sand served as the control.

The acute toxicity of the sandblasting sands and the Duwamish Waterway sediments was measured using the 10-day, amphipod sediment test of Swartz et al., (1985). The survival, emergence, and reburial ability of the marine amphipod, Rhepoxynius abronius, served as the criteria for measuring the toxicity of these samples.

The amphipod bioassays were conducted using five replicates. Each replicate consisted of 300 grams of sample (2 cm deep), and approximately 700 mL of seawater seeded with 20 amphipods. Sand collected from West Beach on Whidbey Island, WA was used as the control. Seawater pumped from Clam Bay (site of EPA Region 10 Laboratory) was used as the overlying water.

Results and Discussion:

The responses of the daphnids to the sandblasting sands and to sediments from Lake Union are presented in Table 1. Amphipod responses to the sandblasting sands and to the Duwamish Waterway sediments are shown in Table 2.

(Daphnid Response)

No daphnids survived their 48-hour exposure to test preparations of the sandblasting sands or Lake Union sediments. In fact, no live daphnids were observed during routine visual checks of the test preparations at the end of 24 hours. Daphnid survival in the control sediment preparations ranged from an average of 63% (aerated) to 90% (unaerated). The elevated mortality measured in the aerated control was believed to have resulted from the aeration-induced agitation of the young daphnid test organisms.

With the exception of the relatively low initial dissolved oxygen concentration measured in unaerated Lake Union Sediment #2 (2.3 mg/L), all of the other pH, dissolved oxygen (DO), and salinity conditions measured were considered acceptable.

(Amphipod Response)

The average, 10-day survival of amphipods exposed to the unused sandblasting sands ranged from 10% in "TUF KUT" (EPA 85250850) to 34% in Kleen Blast® (EPA 85250851). The Duwamish Waterway sediments tested also adversely affected amphipod survival. An average of only 17% of the amphipods survived in Sediment #1 (EPA 85250852), while 74% survived in Sediment #2 (EPA 85250853). Amphipod survival in the control (West Beach) sediment averaged 97%.

The measurements of amphipod emergence and reburial ability generally displayed the same pattern of toxicity as that revealed by amphipod survival. For example, the unused "TUF KUT" sandblasting sand appeared to be the most toxic, with an average of 10 amphipods emerged and 60% of the survivors unable to rebury. Duwamish Waterway Sediment #2 appeared to be the least toxic with an average of 1.6 amphipods emerged and 4% of the survivors not reburying. Control (West Beach) sediment appeared non-toxic, with an average of only 0.4 amphipods emerged and all survivors reburying.

The pH, dissolved oxygen (DO), and salinity (S ‰) conditions measured during the amphipod tests were considered to be within acceptable limits. The interstitial water salinity of Duwamish Waterway Sediment #2 (23 ‰) was slightly lower than the recommended test salinity of ≥ 25 ‰. However, it was above a lower threshold of 21.8 ‰ shown by Swartz et al., (1985) not to adversely affect amphipod survival.

It is possible that the coarse, abrasive nature of the unused sandblasting sands may have stressed the amphipods to some degree. However, the overall response of the amphipods, coupled with the rapid, total daphnid mortality observed in the water column above the sandblasting sands (Table 1), was a strong indication of the presence of toxic conditions ---not simply physical stress or abrasion. The results of the chemical analysis of the sandblasting sands should aid in the assessment of this preliminary finding.

Response to Reference Toxicants:

The responses of the daphnids and amphipods to the Reference Toxicant, sodium pentachlorophenate (PCP), are noted at the bottom of Tables 1 and 2, respectively.

In both cases, the responses of the test organisms were within acceptable limits (EPA/EMSL-Cincinnati, "Instructions for Reference Toxicants-Sodium Pentachlorophenate"; Cummins, J.M. and C.E. Gangmark, Unpublished Data).

References:

Nebeker, A.V., M.A. Cairns, J.H. Gakstatter, K.W. Malueg, G.S. Schuytema, and D.F. Krawczyk. 1984. Biological methods for determining toxicity of contaminated freshwater sediments to invertebrates. *Environ. Toxicol. and Chem.* 3: 617-630.

Swartz, R.C., W.A. DeBen, J.K.P. Jones, J.O. Lamberson, and F.A. Cole. 1985. Phoxocephalid amphipod bioassay for marine sediment toxicity. In *Aquatic Toxicity and Hazard Assessment: Seventh Symposium*, ASTM STP 854, R.D. Cardwell, R. Purdy, R.C. Bahner, Eds. ASTM, Philadelphia, pp. 284-307.

U.S. Environmental Protection Agency. Instructions for reference toxicants-sodium pentachlorophenate. Environmental Monitoring and Support Laboratory, Cincinnati, OH. 2p.

Table 1.

Response of the Freshwater Daphnid, *Daphnia pulex*, to
Unused Sandblasting Sands and Lake Union Sediments.

Sample Description	EPA Sample Number	Percent Daphnid Survival ^a (48-hour)		Overlying Water ^b			
				0-hour		48-hour	
				pH	DO (mg/L)	pH	DO (mg/L)
Unused Sandblasting Sand; R. A. Barnes	85250850	Aerated	0	-	-	8.23	8.6
		Unaerated	0	8.37	8.7	8.13	8.7
Unused Sandblasting Sand; Kleen Blast®	85250851	Aerated	0	-	-	8.24	8.5
		Unaerated	0	8.32	8.7	8.12	8.5
Lake Union Sediment #1	85250854	Aerated	0	7.85	7.7	8.02	8.3
		Unaerated	0	7.60	4.2	7.53	4.9
Lake Union Sediment #2	85350855	Aerated	0	8.01	8.1	7.87	8.3
		Unaerated	0	7.56	2.3	7.47	5.5
Control Sediment West Beach Sand Whidbey Island, WA., Washed and Dried	----	Aerated	63	-	-	7.96	7.9
		Unaerated	90	8.01	8.8	7.40	5.1
Control Culture Medium	----	Unaerated	95	8.27	8.7	8.3	8.6

^a Aerated data based on mean of
three replicates.

Unaerated data based on one
test preparation.

^b Salinity of overlying water 0 ‰.

NOTE: Reference Toxicant Results - Sodium Pentachlorophenate, Source: EPA/EMSL Cincinnati, OH.
LC50 (0.61 mg/L)
95% Confidence Interval (0.53 - 0.73 mg/L)

Table 2.

Responses of the Marine Amphipod, Rhepoxynius abronius, to
Unused Sandblasting Sands and Duwamish Waterway Sediments

Sample Description	EPA Sample Number	Mean Amphipod Responses ^a (Day 10)				Sediment	Overlying				Water
		No. of Survivors	Percent Survival	Percent Survivors Not Reburying ^b	No. of Amphipods Out of Sediment ^c	Intersti- tial Water	Day 0			Day	
						S ^o /oo	pH	DO (mg/L)	S ^o /oo	pH	DO (mg/L)
Unused Sandblasting Sand, R.A. Barnes	85250850	2.0	10	60	10	28 ^d	8.05	7.5	27	8.07	7.9
Unused Sandblasting Sand, Kleen Blast [®]	85250851	6.8	34	41	9.6	28 ^d	8.09	7.1	28	8.05	7.8
Duwamish Waterway Sediment #1	85250852	3.4	17	53	7.4	28	8.03	7.0	27	8.26	7.8
Duwamish Waterway Sediment #2	85250853	14.8	74	4	1.6	23	8.03	7.2	27	8.37	7.9
Control Sediment, West Beach Sand Whidbey Island, WA	----	19.4	97	0	0.4	28	8.08	7.2	28	8.35	8.2

^a Mean of five replicates

^b Percent of survivors on Day 10 not reburying
in control sediment in one hour.

^c Mean number of amphipods observed floating,
swimming, or on the sediment surface on
Day 10.

^d Sandblasting sand, originally in a dry state,
was mixed with overlying seawater having a
salinity of 28 ‰.

NOTE: Reference Toxicant Results - Sodium Pentachlorophenate, Source: EPA/EMSL Cincinnati, OH.

LC50 (0.37 mg/L)

95% Confidence Interval (0.34 - 0.40 mg/L)

Summary of Metals Analysis

	Unused Sand "R.A. Barnes" 85250850	Unused Sand "Kleen Blast" 85250851	Dunsmuir 30' in from Synchro 85250852	Dunsmuir adjacent to upstream dolphin, near Synchro 85250853	Lake Union Middle Slip West side of MPE 85250854	Lake Union 10-15' of dry dock (3rd from W) 85250855
<u>Sediment</u>	mg/kg	mg/kg	mg/kg	mg/kg		
As	3460	24.8	9750	244	2760	3940
Ba	17	18	32	22	89	49
Cd	4.72	.05	4.59	1.77	3.66	3.94
Cr	109.8	50.3	103.1	38.1	98.7	55.7
Cu	4470	1910	3400	565	2420	2470
Pd						
Ag	4.23	1.17	.34	1.01	4.84	6.71
Zn	19,350	323	10,480	1884	8800	31,200
Se	1.5	0.6	0.8	0.8	1.7	2.7
Hg	.003	.0034	0.062	0.096	0.492	0.184
<u>EP Toxicity</u>	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
As	1	14	6	10	113	71
Ba	170	110	450	210	940	590
Cd	24.8	0.4	8.7	7.4	3.9	5.7
Cr	14	14	14	14	14	14
Cu	5328	1163	79.0	80	1	2.0
Pd	50	14	4	2	95	123
Ag	0.1	0.1		0.1	0.1	0.1
Zn	2075	141	11,080	34,000	40,100	77,600
Se	4	3	2	1	14	14
Hg	0.054	.054	.054	.05	.05	.054